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EDUCATION & OUTREACH

SPURS

Salinity Processes in the Upper Ocean Regional Study

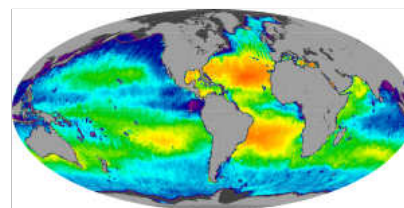
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## Education and Outreach Resources

Salinity Processes in the Upper Ocean Regional Study (SPURS) is a large-scale, ocean-based scientific study lead by NASA that is actively addressing the essential role of ocean salinity in the global water cycle through an investigation at the salinity maximum region in the middle of the Northern Atlantic Ocean.

SPURS scientists hope to improve our basic understanding of the water cycle over the oceans and ultimately, its ties to ocean circulation and climate. Use this section to explore in more depth and detail scientist and educator-vetted educational resources related to the SPURS research effort.

- River of Salt [\[JUMP\]](#)
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Slideshow of composite SSS data taken by the NASA Aquarius instrument. Hover over images to see month.

### SPURS Planning Blog



Dr. Raymond Schmitt, Chief Scientist for the SPURS project, is a Senior Scientist at Woods Hole Oceanographic Institute focusing on physical oceanographic processes. He has been on both the Fall 2012 and the March 2013 SPURS expeditions, the latest of which is currently under way. Aboard the *R/V Endeavor*, Dr. Schmitt will be writing occasional posts describing the events being played out within the SPURS study site, details of which can be found on the [SPURS Planning Blog](#).

### Sarmiento de Gamboa SPURS Cruise Blog



**International Collaborations:** The second round of SPURS expeditions is currently underway, with researchers from around the world working together to collect more data from the SPURS study site. The *R/V Sarmiento de Gamboa* hails from Spain and on this cruise, will be studying mesoscale (spatial scales of 100km and smaller) and submesoscale (occurring within the first kilometer of the ocean) processes within the SPURS study site, among other things. The Sarmiento is keeping a cruise blog, written in Catalan, with updates from the ship. [Click here](#) to see what they're up to!

### Seeking Salt: Measuring a Key Ingredient of Climate



View our three-part [webinar series](#) to find out how SPURS scientists seek to better understand ocean salinity, which affects everything from the water cycle to climate change. Each webinar features an interactive concept map loaded with educational resources that can serve as a starting point for you to "sprinkle" ocean salinity into your teaching. We also identify applicable Next Generation Science Standards (in development).

### Salinity Processes in the Upper Ocean Regional Study (SPURS) Blog



**Follow the SPURS cruise day-by-day!** On September 6, a bunch of NASA-funded scientists departed on an expedition across the North Atlantic Ocean to study salt concentration levels in seawater. Eric Lindstrom, in his role as one of the NASA program scientists - and on this cruise, as an "intrepid sea blogger" - will enlighten us as to why they want to spend six weeks at sea measuring ocean saltiness! Over the coming months, get caught up in the action through this blog and learn more about their scientific motivations. Follow along as Eric, with his keen eye and expert knowledge, introduces us to "the science, the scientists and technicians headed to sea, their individual contributions to the field campaign, and the amazing technology that makes it all possible". Questions and comments from the public, teachers and students are most welcome!

### Sampling Strategy Challenge: Interactive Lesson Plan



**Want to plan like a scientist?** Determining where and when to deploy scientific equipment is an important part of any ocean-going cruise. SPURS scientists use a sophisticated computer model (online JPL Trajectory Tracking Tool) that allows scientists to run "tracking simulations" to determine the best deployment areas to accomplish their science goals during the cruise - and you can too!

This is a step-by-step interactive lesson plan that can help your students understand the process behind planning a cruise of this magnitude as they become familiar with the challenges scientists face in conducting research on the open ocean. Both [teacher](#) and [student](#) instructions are available.

### NASA Aquarius Instrument: Education Pages



**Learn more about salinity in the ocean and the Aquarius instrument on the SAC-D satellite**, one of the many sources of salinity data utilized during the SPURS cruise, and how it measures Sea Surface Salinity (SSS) with unprecedented resolution and global coverage every seven days. This website demonstrates how better understanding of salinity-driven ocean circulation - and its influence on climate and the water cycle - can benefit student learning and society as whole.

On these pages, among the many resources available, you will find: student learning outcomes, salinity basics, classroom activities, and data-driven tools, along with webinars featuring Aquarius scientists.

### Salinity: Basic Resources

[Salt of the Earth: Salinity, Temperature & Density](#) [flash video with teaching resources]

*Salt is really a molecule in ocean water, but collectively, it plays a role in ocean circulation*

[The Power of Sea Salt](#) [video]

A ScienceCast movie from Science at Nasa

[Ocean Salinity Viewed from Sea and Space](#) [SPURS blog]

NASA Program Scientist Eric Lindstrom describes why scientists want to spend six weeks at sea measuring ocean saltiness

[Salinity Basics](#) [website]

How much salt is there? Where does the salt come from? Is salinity uniform throughout the ocean? Answers to these questions and more

[Interactive Salinity Questions](#) [interactive website]

Questions and answers about sea surface salinity from the Aquarius Education Technology Team

[Ocean Circulation and Climate](#) [website]

Ocean salinity's influence on the environment can be summarized by looking at Earth's three major latitude zones: high latitudes, mid-latitudes, and the tropics

[Salinity Data and Tools](#) [suite of interactive tools]

Find the data set that most closely corresponds to sea surface salinity patterns

[Aquarius Student Outcomes](#) [website]

Twenty three student outcomes addressed by Aquarius EPO materials and aligned with National Science Education Standards

[Aquarius Classroom Activities](#) [website]

"Hands on" laboratory activities for Grades K-12

## ■ Water Cycle Basics and Intensification

[Water Cycle Overview](#) [NASA animation]

This animation depicts a cross-sectional view of a coastal area

[Precipitation, Evaporation and Condensation](#) [NASA animation]

Water falling from summer storm clouds onto a field of wheat today will someday fall again somewhere else - this is the essence of the water cycle

[Aquarius Water Cycle](#) [NASA animation]

How does water move? Through the water cycle, the process by which water circulates from the ocean, to the atmosphere, to the land, and then back to the ocean

[Water, Water Everywhere: Water Cycle & Climate Change](#) [flash video with teaching resources]

The water cycle affects and is affected by climate variations

[An Oceanographer and the Water Cycle](#) [SPURS blog]

If one wants to find out what the water cycle is doing, one should be looking at the oceans

[What Does Sea Surface Salinity Tell Us About the Global Water Cycle?](#) [suite of scientist-created concept maps]

Concept map created by Dr. Felix Landerer at the June 2011 [NASA/JPL Workshop](#) in Pasadena, CA

[Ocean Salinities Reveal Strong Global Water Cycle Intensification During 1950 to 2000](#) [scientific article]

Long-term changes to the ocean salinity field provide an insight into water cycle change expressed by E-P changes

[Ocean Salinity Trends Show Human Fingerprint](#) [news article]

Like ocean temperature, variations in the last half-century are only explicable in the context of human-caused climate change

[Big Changes in Ocean Salinity Intensifying Water Cycle](#) [scientific article]

Rapidly changing ocean salinities as a result of a warming atmosphere have intensified the global water cycle by an incredible 4 percent between 1950 and 2000

[Dry Lands Getting Drier, Wet Getting Wetter: Earth's Water Cycle Intensifying With Atmospheric Warming](#) [scientific article]

A clear change in salinity has been detected in the world's oceans, signalling shifts and an acceleration in the global rainfall and evaporation cycle

[Earth's Water Cycle Is Intensifying, Dry Is Getting Drier and Wet Is Getting Wetter](#) [scientific article]

The Earth's water cycle is intensifying, leading to more evaporation in dry climates and more rain in wet climates

[Interactive Data Tools for Changes in Salinity Over Time](#) [interactive tools]

Annual cycle maps and time-series plots for salinity, temperature, and density

[The Water Cycle Activity](#) [lesson plans/activities]

This activity focuses on two aspects of the water cycle: evaporation and condensation

## ■ Ocean Deserts: Regions of Salinity Maximum

[Geographic Variation in Salinity](#) [flash video with teaching resources]

Dr. Susan Lozier, Duke University, describes an 'ocean desert'

[Ocean Salinity Viewed from Sea and Space](#) [SPURS blog]

NASA Program Scientist Eric Lindstrom describes why scientists want to spend six weeks at sea measuring ocean saltiness

[Interactive Data Tools for Finding Salinity Spatial Patterns](#) [interactive tools]

Annual cycle maps and time series plots for salinity, temperature, and density

## ■ Ocean Salinity: Links to Global Climate Through Ocean Circulation

[An Oceanographer and the Water Cycle](#) [SPURS blog]

If one wants to find out what the water cycle is doing, one should be looking at the oceans

[Climate Change and the Global Ocean: Monitoring Climate Change Impacts By Satellite](#) [flash video with teaching resources]

Soon a new satellite will even help us see tiny particles on the ocean's surface - like salt, which drives huge conveyor belts of water through the world's oceans

[Salt of the Earth: Ocean Atmosphere Circulation Helps Moderate Climate](#) [flash video with teaching resources]

Things that happen now will still be manifest hundreds of years in the future

[Ocean Circulation](#) [website]

A compilation of videos, activities, tools, and articles relating to ocean circulation

[How Understanding Salinity Helps Us Understand Climate Change](#) [concept map with archived webinar]

Part III of this COSEE-OS webinar focuses on the formation and melting of sea ice and how this affects ocean circulation

[How Does Salinity Drive Ocean Circulation?](#) [concept map]

Concept map created by Dr. Tony Lee at the June 2011 [NASA/JPL Workshop](#) in Pasadena, CA

[Density: Sea Water Mixing & Sinking](#) [lesson plan/activity]

Temperature and salinity help govern the density of seawater, which is a major factor controlling the ocean's vertical movements and layered circulation

[Liquid Rainbow](#) [lesson plan/activity]

When solutions of two different densities meet, the lower density solution will move on top of the higher density solution, resulting in a layering or stratification of the solutions



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